

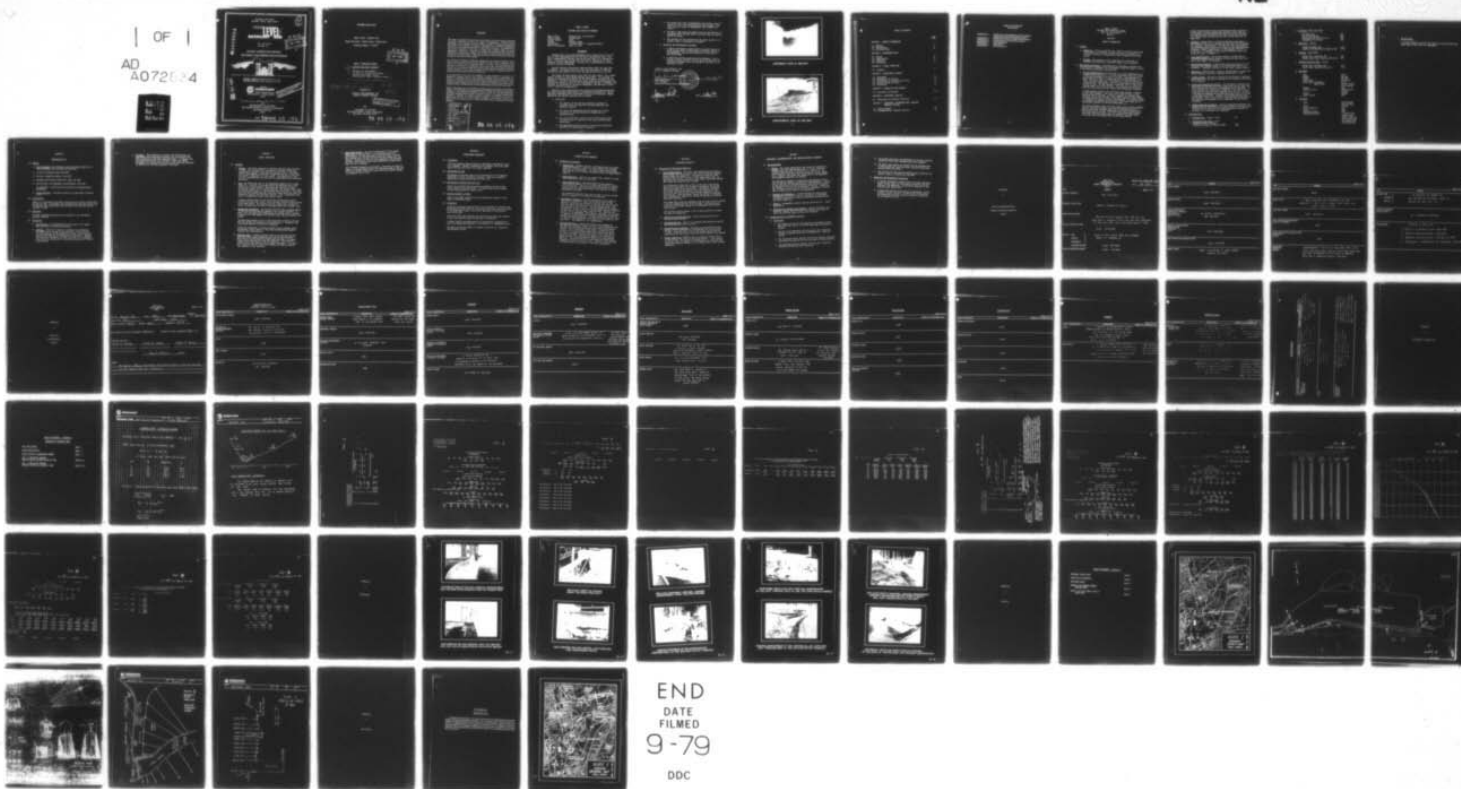
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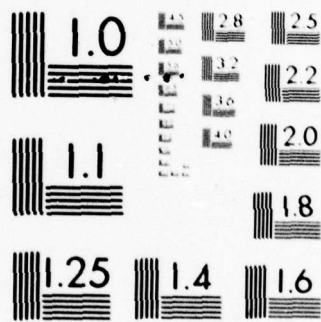
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NATIONAL DAM SAFETY PROGRAM. BERNHART DAM. NDI-PA-00717. PA DER--ETC(U)
JUL 79
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NATIONAL BUREAU OF STANDARDS-1963-A

DELAWARE RIVER BASIN
BERNHART CREEK BERKS COUNTY

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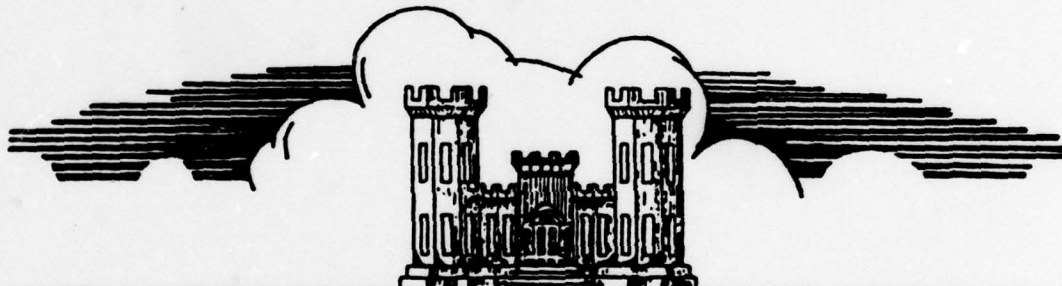
PENNSYLVANIA
LEVEL
BERNHART DAM

NDI - PA 00717
PA DER 6-1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Prepared By
O'BRIEN & GERE

Justin & Courtney Division
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FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

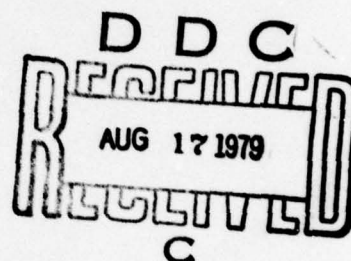
JULY 79⁹⁷⁹08 15 073

DELAWARE RIVER BASIN

Name of Dam: Bernhart Dam

County and State: Berks County, Pennsylvania

Inventory Number: PA 00717



PHASE I. INSPECTION REPORT

6 NATIONAL DAM SAFETY PROGRAM.

Bernhart Dam. NDI-PA-00717.
PA DER-6-1. Delaware River Basin.
Bernhart Creek, Berks County,
Pennsylvania. Phase I Inspection Report.

15 PACW 31-79-C-0010

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION

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For:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Bernhart Dam ID # PA 00717
State Located: Pennsylvania
County Located: Berks
Stream: Bernhart Creek
Coordinates: Latitude 42°22.7', Longitude 75°54.5'
Date of Inspection: April 3, 1979

ASSESSMENT

Bernhart Dam is an earth embankment with a masonry brick core wall and a 5-foot high masonry wall at the top of the upstream face. The dam is approximately 180 feet long and 30 feet high at its maximum section. A 40-foot wide concrete drop spillway is located at the right abutment (looking downstream). The dam site is approximately one mile north of the City of Reading.

Bernhart Dam was constructed sometime before 1865, the exact date is unknown. The masonry brick core wall was constructed in 1896 and the masonry gate house on the top of the dam was built prior to 1913.

The chosen Spillway Design Flood (SDF) for this "Small" size, "High" hazard structure is the Probable Maximum Flood (PMF). The spillway is capable of discharging 24 percent of the PMF without overtopping of the embankment. Failure of the dam would cause excessive property damage and increase the hazard to loss of life downstream of the dam. Therefore, the spillway is classified as "Seriously Inadequate", and the dam is classified as "Unsafe (non-emergency)".

Based on visual observations and review of the information obtained from the Pennsylvania Department of Environmental Resources Division of Dam Safety, Bernhart Dam is considered to be in fair condition. Recommendations and remedial measures are as follows:

a. Facilities

1. The capacity of the spillway should be increased in accordance with the results of further hydrologic and hydraulic studies.
2. The top of the embankment and the masonry wall should be restored to design elevation as determined by a detailed survey.
3. The sluice gate which controls the 16-inch diameter blow-off pipe should be repaired and the pipe should be made operational.
4. The downstream spillway channel training walls should be repaired and replaced where necessary.

5. The eroded path along the embankment and spillway junction should be filled with compacted earth and reseeded. Measures should be taken to accommodate future pedestrian traffic.
6. The small trees should be removed from the upstream face of the masonry wall and the cracks from which they are growing should be sealed.
7. The spillway for the upstream settling basin should be repaired so that it functions as designed.

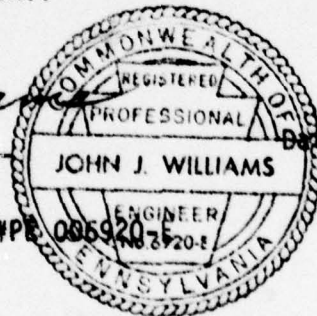
b. Operation and Maintenance Procedures

1. A regular maintenance program should be established which would include repair of the masonry structures, mowing of the embankment, and periodic operation of the blow-off pipe sluice gate.
2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and downstream residents should be alerted in the event of an impending failure.

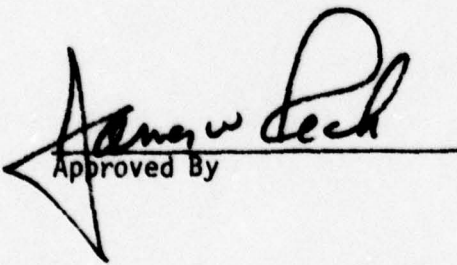
O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION


John J. Williams
Vice President

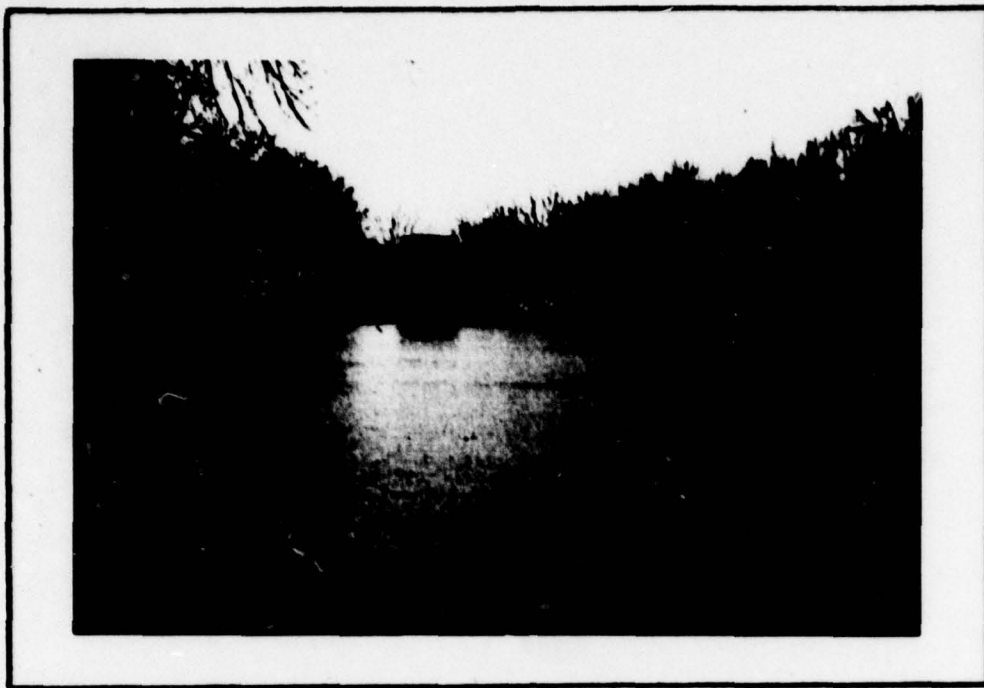
Pennsylvania Registration #PE 005920-E



Date: 20 July '79


Approved By

Date: 1 Aug 79



UPSTREAM FACE OF THE DAM



DOWNSTREAM FACE OF THE DAM

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
NDI I.D. NO. PA 00717
DER #6-1

SECTION 1

PROJECT INFORMATION

1.1 General

- a. Authority. The Dam Inspection Act, Public Law 92-367 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.
- b. Purpose. The purpose of this inspection is to determine if Bernhart Dam constitutes a hazard to human life or property.

1.2 Description of Project. (Supplemented by information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania).

- ABSTRACT →
- a. Dam and Appurtenances. Bernhart Dam is an earth embankment with a masonry brick core wall. A 5-foot high masonry wall is located at the upstream edge of the top of the dam. The embankment is approximately 180 feet in length and has a maximum height of 30 feet. The side slopes are 2 horizontal to 1 vertical (2H:1V) upstream and 3H:1V downstream. The top of dam width varies between 22 and 35 feet. The dam impounds a reservoir with a normal pool storage capacity of 129 acre-feet. The reservoir was originally used for water supply but now serves only recreational purposes.

A broad-crested spillway with a 40-foot crest length is located at the right abutment. The crest is at Elevation 395; 5 feet below the top of the dam. A masonry sidewall is provided along the left side of the spillway. The right sidewall of the spillway is formed by the nearly vertical rock abutment. The outlet channel is provided with masonry training walls along both sides for an approximate distance of 300 feet downstream. ←

ABSTRACT

Two 30-inch diameter pipes for water supply and a 16-inch diameter pipe for reservoir drawdown lead into the upstream side of a masonry gate house located approximately 85 feet from the spillway on the top of the dam. The three sluice gates which control the inflow from the three pipes are located in the gate house, as are the two sluice gates which control the outflow.

A small settling basin with an approximate storage capacity of 6 acre-feet is located immediately upstream of the reservoir. The settling basin discharges flow into the reservoir by means of a 50-foot long spillway section with a crest elevation of about 399.

- b. Location. Bernhart Dam is located on Bernhart Creek about 1 mile north of the City of Reading and just south of the Borough of Laureldale, Pennsylvania. The dam site lies within Muhlenberg Township, Berks County and is shown on the USGS Quadrangle entitled, "Temple, Pennsylvania" at coordinates N 42° 22.7', W 75° 54.5'. A regional vicinity plan of Bernhart Dam is enclosed as Plate 1, Appendix E.
- c. Size Classification. The maximum height of 30 feet and an estimated maximum storage capacity of 203 acre-feet place the dam in the "Small" size category.
- d. Hazard Classification. A dam failure could cause loss of lives and extensive property damage in the downstream community of Bernharts. Therefore, the dam is in the "High" hazard category.
- e. Ownership. Bernhart Dam is owned by the Department of Parks and Public Property, City Hall, Reading, Pennsylvania 17120.
- f. Purpose of Dam. The dam was originally constructed to impound a water supply for the City of Reading and is presently used solely for recreation.
- g. Design and Construction History. The information obtained indicates that the dam was originally constructed earlier than 1865. The structure was originally a homogeneous earth embankment. A brick corewall was constructed in 1896 and a gate house was incorporated into the structure sometime prior to 1913. In 1921, a new dam was proposed and designed which would raise the height of the dam over 20 feet. However, the proposed dam was never constructed. There is no record in the available information of any construction subsequent to the completion of the original structure.
- h. Normal Operating Procedures. The only operating mechanisms for Bernhart Dam are the three sluice gates located in the gate house. According to Mr. George Patton, Water Department Engineering Director, all three gates are inoperable.

1.3 Pertinent Data

- a. Drainage Area. (square miles) 2.6
- b. Discharge at Dam Site. (CFS)
Maximum spillway discharge
(reservoir surface at Elevation 400) 1390

c. Elevation. (feet above MSL)

Spillway Crest	395
Top of Dam (Design)	400
Settling Basin Pool Elevation	399
Streamed at Toe of Dam	370

d. Reservoir. (miles)

Length of Normal Pool	0.25
Length of Maximum Non-overtopping Pool	0.28

e. Storage. (acre-feet)

Normal Pool, Elevation 395	129
Design Top of Dam, Elevation 400 (est.)	203

f. Reservoir Surface Area. (acres)

Normal Pool, Elevation 395	13.3
Top of Dam, Elevation 400 (est.)	17.0

g. Dam Data.

Type	Earth
Length	180 feet
Height	30 feet
Crest Width	22-35 feet
Side Slopes (Upstream)	2H:1V
(Downstream)	Variable slope; 3H:1V average
Zoning	None
Impervious Core	Masonry brick corewall
Cutoff	Unknown
Grout Curtain	None

h. Spillway.

Type	Broad-crested drop spillway
Width	40 feet
Crest Elevation	395
Gates	None
Upstream Channel	None
Downstream Channel	A 16-foot wide channel with masonry training walls extends ap- proximately 300 feet downstream

1. Outlet Works.

A 16-inch diameter blow-off pipe leads into the gate house and downstream to the toe of the embankment.

SECTION 2

ENGINEERING DATA

2.1 Design

- a. Data Available. The information made available by DER for review of Bernhart Dam includes the following:

1. A set of 6 drawings dated 1894-1908
2. Periodic inspection reports, 1919-1970
3. Drawdown applications dated 1945, 1953, and 1958
4. Miscellaneous correspondence and memoranda, 1913-1970.

An additional 10 drawings were provided by the Reading Water Department.

- b. Design Features. The design features are described in Section 1.2.a.

2.2 Construction

There is no information available concerning the original construction of Bernhart Dam. An undated report (between 1932 and 1939) states that the dam was built before 1865 and that the brick core wall was constructed in 1896.

2.3 Operation

No formal operating procedures were included in the information obtained from DER.

2.4 Evaluation

- a. Availability. The engineering data utilized in this report were provided by the Pennsylvania DER.
- b. Adequacy. There is no design or construction information available due to the age of the structure. There are also no cross-sections of the embankment included in the drawings obtained from DER and the Reading Water Department. However, the available information (listed in Section 2.1.a) combined with the visual inspection is considered adequate for a Phase I investigation.

- c. Validity. The elevations provided on the DER drawings and the Reading Water Department drawings are inconsistent with those indicated on the USGS Quadrangle Sheet. It appears that the obtained elevations were referred to some local datum. Throughout this report the elevations given have been converted to conform with the USGS Quadrangle elevations.

SECTION 3
VISUAL INSPECTION

3.1 Findings

- a. General. The field inspection of Bernhart Dam took place on April 3, 1979. At the time of the inspection, the water surface was approximately one-half inch above the spillway crest. The observations and comments of the field inspection team are in the check list which is Appendix B of this report. The appearance of the facility indicated that the dam and its appurtenances are marginally maintained.
- b. Dam. The downstream face of the embankment appears to be in good condition. The only visible portion of the upstream face is the masonry wall which extends 5 feet above the reservoir surface. The masonry appears to be in good condition, but several small trees are growing from cracks in the upstream face of the wall. The grass cover has been eroded away and a path has formed along the crest and downstream slope at the spillway junction. This is apparently the result of pedestrian traffic and surface runoff.

A survey revealed that the top of dam has settled below design elevation by more than a foot along a 20-foot stretch in the vicinity of the gate house. The elevation of the lowest point surveyed is 398.8, allowing only 3.8 feet of freeboard above the spillway crest.

- c. Appurtenant Structures. The spillway vertical drop is approximately 15 feet and the drop section appears to be in good condition. A metal truss and wood deck bridge spans the spillway with a minimum clearance of 5 feet between the spillway crest and the bottom of the bridge.

The gate house appears to be in good structural condition, but the door and windows are boarded up to prevent entry. Therefore, the sluice gate controls could not be inspected.

During the inspection, a 36-inch diameter pipe of unknown origin discharging a small amount of flow into the downstream channel from the left training wall.

- d. Reservoir Area. A brick spillway controls the outflow from the settling basin located immediately upstream of the reservoir. Both ends of the spillway have eroded away and water is flowing freely around the ends and into the reservoir. The reservoir slopes on the right side are fairly steep and wooded. The reservoir slopes on the left side are variable, but they are fairly flat adjacent to the reservoir.

- e. Downstream Channel. The left training wall of the channel downstream of the spillway is in dilapidated condition. Approximately 150 feet downstream of the spillway, the wall has crumbled and a 30-foot long section has toppled into the channel. Portions of the wall have completely disintegrated and both training walls have been undermined in places where they are still standing.

The residential community of Bernharts, consisting of about 20 homes, is located approximately 300 feet downstream of the dam. Failure of Bernhart Dam would cause excessive property damage and probable loss of life.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

A 16-inch diameter blow-off pipe was originally provided for reservoir drawdown. However, according to Mr. Patton, the sluice gate which controls this pipe is no longer operable.

4.2 Maintenance of Dam

Maintenance of Bernhart Dam is the responsibility of the Reading Department of Parks and Public Property. There is no regular maintenance program established for this site.

4.3 Maintenance of Operating Facilities

There are no established maintenance procedures for the sluice gates located in the gate house. The gate house does not appear to have been entered in several years.

4.4 Warning Systems in Effect

There is no formal system of warning downstream residents in the event of impending danger.

4.5 Evaluation

A regular maintenance program should be established for Bernhart Dam which would include repair of the masonry structures, periodic mowing of the embankment grass, and periodic operation of the blow-off pipe sluice gate.

The sluice gate which operates the blow-off pipe should be repaired so that the reservoir may be drawn down if necessary.

A formal warning procedure should be developed and implemented to alert the downstream residents in the event of an impending failure.

The dam is accessible under all weather conditions for inspection and emergency action.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

- a. Design Data. Bernhart Dam has a drainage area of 2.6 square miles and impounds a reservoir with a normal pool storage capacity of 129 acre-feet. The 40-foot wide broad-crested drop spillway has a maximum discharge capacity of approximately 1,400 cfs.
- b. Experience Data. There is no evidence that rainfall or water level records are kept for this dam.
- c. Visual Observations. The downstream spillway channel is constricted by the section of training wall that has toppled into the channel. The training walls have become so deteriorated along the downstream channel that they are no longer considered functional.

The inoperable blow-off pipe could present a serious problem should a drawdown of the reservoir be required.

- d. Overtopping Potential. The Spillway Design Flood (SDF) for this dam is given as a range from $\frac{1}{2}$ PMF to the full PMF. Based on the height and storage of Bernhart Dam and the potential for damage and loss of life at the hazard center, the SDF selected is the full PMF. The PMF hydrograph was routed through the reservoir with the starting water surface elevation at the crest of the spillway, Elevation 395. Based on the results of the hydrologic and hydraulic analyses, the spillway is capable of discharging approximately 24 percent of the PMF without overtopping the dam. The peak inflow and outflow rates for the SDF were determined to be 5,628 cfs and 5,582 cfs respectively. (see Appendix C for computations)
- e. Spillway Adequacy. A dam break analysis was computed to evaluate the increased "hazard to loss of life downstream from the dam from that which would exist just before overtopping failure" (ETL 1110-2-234, 10 May 1978). According to the analysis, failure of Bernhart Dam would increase the depth of flow at the hazard area from 5.2 feet to 6.7 feet for 30 percent of the PMF. The peak discharge at the hazard area would increase from approximately 1,680 cfs to approximately 3,370 cfs. Failure of the dam is considered to significantly increase the hazard to loss of life. Therefore, the spillway of Bernhart Dam is classified as "Seriously Inadequate".

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations. The small trees growing out of cracks in the upstream face of the masonry wall create potential seepage paths through the embankment. The point at which the trees protrude from the wall is about 2 feet above normal pool, so during periods of high reservoir level, water could seep through the cracks and along the root systems.

The depression of more than a foot in the top of the dam appears to be the result of differential settlement due to the additional weight of the gate house. The general settlement of several inches which extends along the remainder of the top of the dam could be the result of poor compaction during construction. Such settlement reduces the amount of freeboard and, consequently, reduces the ability of the dam to withstand high pool elevations.

The eroded path along the embankment and spillway junction creates a natural seepage path for surface runoff. Continued erosion could lead to possible damage to the embankment and spillway training wall.

The spillway section appears to be in good condition and shows no signs of instability.

- b. Design and Construction Data. There are no design and construction data available.
- c. Operating Records. There is no evidence that operating records are maintained for this structure.
- d. Post-Construction Changes. According to the available information, a brick core wall was incorporated into the structure in 1896. Sometime prior to 1913, the masonry gate house was constructed and the intake structure in the reservoir was removed.
- e. Seismic Stability. Bernhart Dam is located in Seismic Zone 1 of the "Seismic Zone Map of Contiguous States". A dam located in Seismic Zone 1 is generally considered to be safe under any expected earthquake loading if it is stable under static loading conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

- a. Safety. The visual observations and review of available information indicate that Bernhart Dam is in fair condition. Problem areas are noted in Sections 5.1.c and 6.1.a. No serious deficiencies were observed during the visual inspection. However, the nature and composition of the embankment and foundation materials are unknown.

The spillway is capable of discharging approximately 24 percent of the PMF without overtopping of the embankment. Failure of the structure by overtopping would significantly increase the hazard to loss of life downstream of the dam. Therefore, the spillway is classified as "Seriously Inadequate", and the dam is classified as "Unsafe (non-emergency)".

- b. Adequacy of Information. Although design and construction information is minimal, a Phase I evaluation is considered reasonable based on the revealing conditions observed during the field inspection.
- c. Urgency. Recommended remedial measures should be implemented immediately.
- d. Necessity for Further Investigation. Further hydrologic and hydraulic studies should be made to determine the extent to which the spillway capacity should be increased.

7.2 Recommendations and Remedial Measures

a. Facilities

1. The capacity of the spillway should be increased in accordance with the results of further hydrologic and hydraulic studies.
2. The top of the embankment and the masonry wall should be restored to design elevation as determined by a detailed survey.
3. The sluice gate which controls the 16-inch diameter blow-off pipe should be repaired and the pipe should be made operable.
4. The downstream spillway channel training walls should be repaired and replaced where necessary.

5. The eroded path along the embankment and spillway junction should be filled with compacted earth and reseeded.
6. The small trees should be removed from the upstream face of the masonry wall and the cracks from which they were growing should be sealed.
7. The spillway for the upstream settling basin should be repaired so that it functions as designed.

b. Operation and Maintenance Procedures

1. A regular maintenance program should be established which would include repair of the masonry structures, periodic mowing of the embankment, and periodic operation of the blow-off pipe sluice gate.
2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and downstream residents should be alerted in the event of an impending failure.

APPENDIX

A

Check List Engineering Data
Design, Construction, Operation
Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM BERNHART DAM

ID # PA 00717

Sheet 1 of 4

ITEM

REMARKS

AS-BUILT DRAWINGS

NONE AVAILABLE

REGIONAL VICINITY MAP

REFER TO APPENDIX E, PLATE 1

CONSTRUCTION HISTORY

THE DAM WAS BUILT EARLIER THAN 1865, BUT THE EXACT DATE IS UNKNOWN. A BRICK CORE WALL WAS CONSTRUCTED IN 1896, AND A GATE HOUSE WAS ADDED PRIOR TO 1913.

TYPICAL SECTIONS OF DAM

NONE AVAILABLE

OUTLETS - PLAN

DETAILS

CONSTRAINTS

DISCHARGE RATINGS

RAINFALL/RESERVOIR RECORDS

PLANS OF THE OUTLET PIPES ARE AVAILABLE.
REFER TO APPENDIX E.

NONE AVAILABLE

NONE AVAILABLE

ITEM

REMARKS

DESIGN REPORTS

NONE AVAILABLE

GEOLOGY REPORTS

NONE AVAILABLE

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIESNO DESIGN COMPUTATIONS
ARE AVAILABLE.MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY }
FIELD }

NONE AVAILABLE

POST-CONSTRUCTION SURVEYS OF DAM

NONE AVAILABLE

BORROW SOURCES

THERE IS NO RECORD OF WHERE BORROW
MATERIAL CAME FROM

ITEM	REMARKS
MONITORING SYSTEMS	NONE
MODIFICATIONS	A BRICK CORE WALL WAS INCORPORATE INTO THE STRUCTURE IN 1896 , AND A MASONRY GATE HOUSE WAS ADDED PRIOR TO 1913 .
HIGH POOL RECORDS	NONE AVAILABLE
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE
MAINTENANCE OPERATION RECORDS	CORRESPONDENCE THROUGH THE YEARS (FROM DER FILES) GIVES INFORMATION ABOUT PERIODIC MAINTENANCE WORK THAT WAS DONE AS REQUIRED BY THE INSPECTION REPORTS. THERE ARE NO OPERATING RECORDS AVAILABLE.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	NO SECTIONS OR DETAILS OF THE SPILLWAY ARE AVAILABLE. REFER TO APPENDIX E FOR PLAN VIEW.
OPERATING EQUIPMENT PLANS & DETAILS	NO INFORMATION AVAILABLE
MISCELLANEOUS	MATERIAL IN DER FILES : 1. A SET OF 6 DRAWINGS DATED 1894-1908 2. PERIODIC INSPECTION REPORTS, 1919-1970 3. DRAWDOWN APPLICATIONS DATED 1945, 1953, AND 1958 4. MISCELLANEOUS CORRESPONDENCE AND MEMORANDA, 1913-1970

APPENDIX

B

Check List
Visual Inspection
Phase I

Sheet 1 of 11

Pool Elevation at Time of Inspection 345.0 ± M.S.L. Tailwater at Time of Inspection 380 ± M.S.L.

LEROY H. DEHEER

STEVEN H. SNIDER

ROBERT R. BOWERS

LEROY H. DEHNER

Recorder

MR. ROBERT MASLEY ACCOMPANIED THE INSPECTION TEAM TO THE DAM SITE BUT
DID NOT REMAIN FOR THE INSPECTION.

CONCRETE/MASONRY DAMS
UPSTREAM MASONRY WALL

Sheet 2 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

ANY NOTICEABLE SEEPAGE

NONE OBSERVED

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

THE TOP OF THE MASONRY WALL
WAS GENERALLY SEVERAL INCHES ABOVE
THE ADJOINING TOP OF THE EMBANKMENT

DRAINS

N/A

WATER PASSAGES

N/A

FOUNDATION

THE FOUNDATION MATERIALS
ARE UNKNOWN

CONCRETE/MASONRY DAMS

Sheet 3 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	SEVERAL TREES WERE GROWING FROM CRACKS IN THE UPSTREAM FACE OF THE MASONRY WALL.	THE TREES SHOULD BE REMOVED AND THE CRACKS SHOULD BE SEALED.

STRUCTURAL CRACKING

NONE OBSERVED

VERTICAL AND HORIZONTAL ALIGNMENT

NO ALIGNMENT PROBLEMS WERE
OBSERVED.

MONOLITH JOINTS

N/A

CONSTRUCTION JOINTS

N/A

EMBANKMENT

Sheet 4 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

SURFACE CRACKS

NONE OBSERVED

UNUSUAL MOVEMENT OR
CRACKING AT OR BEYOND
THE TOE

NONE OBSERVED

SLOUGHING OR EROSION OF
EMBANKMENT AND ABUTMENT
SLOPES

NONE OBSERVED

VERTICAL AND HORIZONTAL
ALIGNMENT OF THE CREST

A VERTICAL DEPRESSION WAS
OBSERVED IN THE VICINITY OF THE GATE HOUSE.
THIS DEPRESSION APPEARED TO BE DIFFERENTIAL
SETTLEMENT DUE TO THE WEIGHT OF THE GATE HOUSE.

RIPRAP FAILURES

NO RIPRAP ON STRUCTURE

EMBANKMENT

Sheet 5 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	NONE OBSERVED	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	A PATH HAS BEEN ERODED ALONG THE TOP OF THE DAM AND THE DOWNSTREAM SLOPE AT THE SPILLWAY AND EMBANKMENT JUNCTION.	THIS PATH SHOULD BE FILLED WITH COMPACTED EARTH AND RESEEDED, AND PROVIDED WITH FLAGSTONES ALONG THE DOWNSTREAM SLOPE.
ANY NOTICEABLE SEEPAGE	NONE OBSERVED	
STAFF GAGE AND RECORDER	NONE	

OUTLET WORKS

Sheet 6 of 11

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

CRACKING AND SPALLING OF
CONCRETE SURFACES IN
OUTLET CONDUIT

N/A

INTAKE STRUCTURE

THE INTAKE STRUCTURE
WAS SUBMERGED

OUTLET STRUCTURE

THE OUTLET END OF THE PIPE
IS LOCATED IN THE LEFT TRAINING
WALL OF THE DOWNSTREAM CHANNEL, APPROX-
IMATELY 250 FEET BELOW THE DAM.

OUTLET CHANNEL

FLOW WOULD BE DISCHARGED INTO
THE SPILLWAY OUTLET CHANNEL.

EMERGENCY GATE

THE SLUICE GATE IS LOCATED IN
THE GATE HOUSE AND IS CURRENTLY
INACCESSIBLE DUE TO THE BOARDED
UP GATE HOUSE. MR. GEORGE PATTON
STATED THAT THE GATE WAS NO
LONGER OPERABLE.

UNGATED SPILLWAY

Sheet 7 of 11

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

CONCRETE WEIR

NO PROBLEMS OBSERVED

APPROACH CHANNEL

NO APPARENT OBSTRUCTIONS

DISCHARGE CHANNEL

THE TRAINING WALLS OF THE
DISCHARGE CHANNEL ARE IN
POOR CONDITION.

THE TRAINING WALLS
SHOULD BE REPAIRED,
RECONSTRUCTED, AND
REPLACED WHERE
NECESSARY.

BRIDGE AND PIERS

A METAL TRUSS AND WOOD DECK
BRIDGE SPANS THE SPILLWAY. THE
BRIDGE MAINTAINS 5 FEET OF
FREEBOARD ACROSS ITS LENGTH.

GATED SPILLWAY

Sheet 8 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

Sheet 9 of 11

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
--------------------	--------------	----------------------------

MONUMENTATION/SURVEYS

NONE

OBSERVATION WELLS

NONE

WEIRS

NONE

PIEZOMETERS

NONE

OTHER

NONE

RESERVOIR

Sheet 10 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	<p>THE RIGHT RESERVOIR SLOPE IS FAIRLY STEEP (UP TO 50%) AND WOODED NEAR THE DAM, BUT FLATTENS OUT UPSTREAM (<10%).</p> <p>THE LEFT RESERVOIR SLOPE RANGES FROM ABOUT 20% NEAR THE DAM TO ABOUT 10% UPSTREAM.</p>	
SEDIMENTATION	<p>A SETTLING BASIN JUST UPSTREAM OF THE RESERVOIR LIMITS THE SEDIMENTATION IN THE RESERVOIR. HOWEVER, THE SETTLING BASIN SPILLWAY IS FRODED ON THE ENDS AND IS NOT FUNCTIONING AS DESIGNED.</p>	<p>THE SETTLING BASIN SPILLWAY SECTION SHOULD BE REPAIRED.</p>

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	THE DOWNSTREAM CHANNEL TRAINING WALLS ARE IN A STATE OF DISREPAIR. PORTIONS OF THE WALLS HAVE FALLEN INTO THE CHANNEL AND CAUSE A GREAT OBSTRUCTION.	THE CHANNEL TRAINING WALLS SHOULD BE REPAIRED AND RECONSTRUCTED, AND REPLACED WHERE NECESSARY.
SLOPES	THE DOWNSTREAM CHANNEL HAS AN INITIAL SLOPE OF ABOUT 1 1/2% AND FLATTENS TO AN APPROXIMATE SLOPE OF 1/2%.	
APPROXIMATE NO. OF HOMES AND POPULATION	THERE ARE ABOUT 20 HOMES AND APPROXIMATELY 100 PEOPLE IN THE RESIDENTIAL COMMUNITY OF BERNHARTS ABOUT 300 FEET DOWNSTREAM OF THE DAM.	A FORMAL WARNING SYSTEM SHOULD BE DEVELOPED AND IMPLEMENTED. PROCEDURES FOR EVALUATING PEOPLE WITHIN THE POTENTIAL FLOOD AREA SHOULD BE IMPLEMENTED.

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	THE DOWNSTREAM CHANNEL TRAINING WALLS ARE IN A STATE OF DISrepair. PORTIONS OF THE WALLS HAVE FALLEN INTO THE CHANNEL AND CREATE A GREAT OBSTRUCTION.	THE CHANNEL TRAINING WALLS SHOULD BE REPAIRED, RECONSTRUCTED, AND REPLACED WHERE NECESSARY.

SLOPES

THE DOWNSTREAM CHANNEL HAS
AN INITIAL SLOPE OF ABOUT 15%
AND FLATTENS TO AN ESTIMATED
SLOPE OF 2%.

APPROXIMATE NO. OF HOMES AND POPULATION

THERE ARE ABOUT 20 HOMES AND
APPROXIMATELY 100 PEOPLE IN THE
RESIDENTIAL COMMUNITY OF BERKSHIRE
ABOUT 300 FEET DOWNSTREAM
OF THE DAM.

A FORMAL WARNING SYSTEM
SHOULD BE DEVELOPED AND
IMPLEMENTED. PROCEDURES
FOR EVALUATING PEOPLE
WITHIN THE POTENTIAL FLOOD
AREA SHOULD BE IMPLEMENTED.

APPENDIX

C

Hydrologic & Hydraulic Data

TABLE OF CONTENTS - APPENDIX C

HYDROLOGIC & HYDRAULIC DATA

PMP CALCULATIONS	SHEET 1
SNYDER COEFFICIENTS	SHEET 1
CROSS SECTION OF DOWNSTREAM CHANNEL	SHEET 2
HEC - 1 DAM SAFETY VERSION COMPUTER OUTPUT WITHOUT BREACH OF DAM	SHEETS 3-8
HEC - 1 DAM SAFETY VERSION COMPUTER OUTPUT WITH BREACH OF DAM	SHEETS 9-16

SUBJECT	SHEET	BY	DATE	JOB NO.
BERNHART DAM, Balt. Corps of Engineers	1	SKS	3/22/79	

HYDROLOGY CALCULATIONS

Drainage Basin (Area planimetered from USGS) = 2.6 sq. mi.

PMP Calculations (HMS REPORT 33)

Area is in Zone 6.

∴ 24-hour, 200 sq. mile PMP = 23.5 inches

HR.	%	RAINFALL	Δ
6	113	26.6	26.6
12	123	28.9	2.3
24	132	31.0	1.1
48	142	33.4	2.4

SNYDER COEFFICIENTS (information supplied by Balt. COE, Area 6)

$$C_p = 0.40$$

$$C_t = 1.35$$

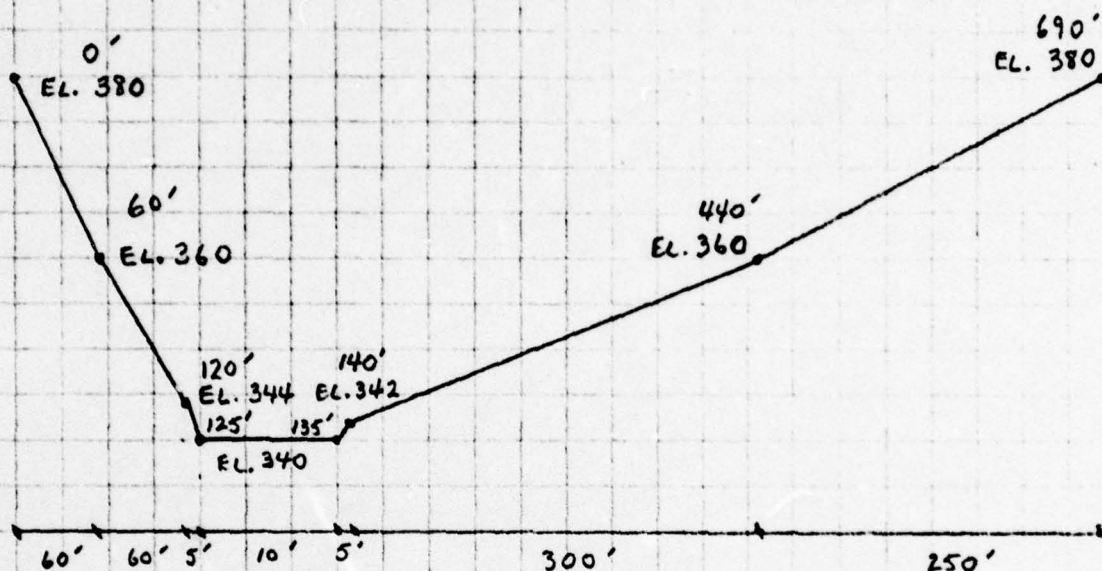
$$t_p = C_t (LL_{co})^{0.3}$$

$$t_p = 1.35 [2.3(0.9)]^{0.3}$$

$$t_p = 1.1$$

SUBJECT	SHEET	BY	DATE	JOB NO.
BEARNHART DAM	2	RRE	4/26/79	

DOWNSTREAM CHANNEL FOR DAM BREAK ANALYSIS



STAGE - SURFACE AREA INFORMATION

THE SURFACE AREA OF THE RESERVOIR AT ELEVATION 369.7 WAS CALCULATED BY THE CONIC METHOD ASSUMING ZERO STORAGE AT THIS POINT.

THE SURFACE AREA AT ELEVATION 412 WAS PLANIMETERED FROM A MAP OBTAINED FROM THE CITY OF READING (ELEVATION WAS CORRECTED TO USGS DATUM).

SHEET 4

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.70 HOURS, CP= .40 VOL= 1.00

55.	199.	345.	387.	345.	295.	252.	215.	184.	157.
134.	115.	98.	84.	72.	61.	52.	45.	38.	33.
28.	24.	20.	17.	15.	13.	11.	9.	8.	7.
4.	4.	4.	4.	3.	3.				

SHEET 5

MO,DA	HR,MIN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO,DA	HR,MIN	PERIOD	RAIN	EXCS	LOSS	COMP Q
<div style="text-align: right;"> SUM 26.70 24.30 2.40 83614. (676.)(617.)(61.)(2367.68) </div>													

HYDROGRAPH ROUTING

ROUTING THROUGH BEHNHANT RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UTFLOW	1	0	0	0	0	1	0	0
ROUTING DATA								
WLOSS	CLOSS	AVG	IRES	ISAMF	IOPT	IPMP	LSTR	
0.0	0.000	0.00	1	1	0	0	0	
NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	-395.	0	
SURFACE AREA= 0. 13. 25.								
CAPACITY= 0. 129. 448.								
ELEVATION= 370. 395. 412.								
CREL	SPWID	COGW	EXPW	ELEVL	COOL	CAREA	EXPL	
395.0	40.0	3.1	1.5	0.0	0.0	0.0	0.0	

DAM DATA			
TOPEL	COOD	EXPD	DAMWID
399.7	3.1	1.5	150.

PEAK OUTFLOW IS	262.	AT TIME	42.50 HOURS
PEAK OUTFLOW IS	534.	AT TIME	42.50 HOURS
PEAK OUTFLOW IS	806.	AT TIME	42.50 HOURS
PEAK OUTFLOW IS	1078.	AT TIME	42.00 HOURS
PEAK OUTFLOW IS	1379.	AT TIME	42.00 HOURS
PEAK OUTFLOW IS	1675.	AT TIME	42.00 HOURS
PEAK OUTFLOW IS	2233.	AT TIME	42.00 HOURS
PEAK OUTFLOW IS	2791.	AT TIME	42.00 HOURS

PEAK OUTFLOW IS 5542. AT TIME 41.50 HOURS

SHEET 6

.....

.....

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SHEET 1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .05	RATIO 2 .10	RATIO 3 .15	RATIO 4 .20	RATIO 5 .25	RATIO 6 .30	RATIO 7 .40	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	INFLOW	2.60	1	281.	563.	844.	1126.	1407.	1688.	2251.	2814.	5628.
	(	6.73)	(	7.97)	(15.94)	(23.91)	(31.87)	(39.84)	(47.81)	(63.75)	(79.68)	(159.37)
ROUTED TO	OUTFLOW	2.60	1	262.	534.	806.	1078.	1379.	1675.	2233.	2791.	5582.
	(	6.73)	(	7.43)	(15.13)	(22.83)	(30.53)	(39.06)	(47.44)	(63.24)	(79.02)	(158.06)

SHEET 8

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	395.10	395.00	399.70
STORAGE	130.	129.	198.
OUTFLOW	4.	0.	1263.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	396.65	0.00	152.	262.	0.00	42.50	0.00
.10	397.65	0.00	166.	534.	0.00	42.50	0.00
.15	398.48	0.00	179.	806.	0.00	42.50	0.00
.20	399.23	0.00	190.	1078.	0.00	42.00	0.00
.25	399.89	.19	201.	1379.	2.00	42.00	0.00
.30	400.24	.54	207.	1675.	3.00	42.00	0.00
.40	400.77	1.07	216.	2233.	4.50	42.00	0.00
.50	401.22	1.52	223.	2791.	6.00	42.00	0.00
1.00	402.99	3.29	254.	5582.	10.00	41.50	0.00

0.3 PMF WITH BREACH OF DAM

SA - SAFETY VIETNAM JULY 1971
-AST MODIFIC 10. 25 SEP 76

NATIONAL DAY INSPECTION PROGRAM									
BERNHART DAM									
PVE HYDROGRAPH									
1	41								
2	42								
3	43								
4	44								
5	45								
6	46								
7	47								
8	48								
9	49								
10	50								
11	51								
12	52								
13	53								
14	54								
15	55								
16	56								
17	57								
18	58								
19	59								
20	60								
21	61								
22	62								
23	63								
24	64								
25	65								
26	66								
27	67								
28	68								
29	69								
30	70								
31	71								
32	72								

Assumed Independent Stage
When Break Occurs

The portion of the dam assumed to be breached is based on the geometry of the site. The depth of flow over the top of the dam at which failure is initiated and the elapsed time to complete failure are based on the general appearance and size of the structure. Consideration was given to the parameters used in the C.O.E. publication "Basic Concepts of Dam Breaks and Development of Dam Break Hydrographs."

El. 399.7

Top of Dam
used in
Breach Aug 19

Shaded Region Assigned
Breached Limits after
1 hr. of Flow with Inground-
current Stage @ EL 400.0

 PLANT MODIFICATION NO. 17
 DATE 11-1-60
 BY J. E. 75

DU DATED 11/1/60
 TIME 11:00.00

SHEET 10

0.3 PMF WITH BREACH OF DAM

NATIONAL DAM INSPECTION PROGRAM
 BERNHART DAM
 PMF HYDROGRAPH

JOB SPECIFICATION
 IDAY 0 IMH 0 IMIN 0 METRC 0 IPLT 0 IPRT -4 NSTAN 0
 JOPER 5 NWT 0 LHOPT 0 TRACE 0

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .30

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO BERNHART RESERVOIR

ISTAO 1COMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO
 INFLOW 0 0 0 0 0 1 0 0

HYDROGRAPH DATA
 IHYDG 1 IUNG 1 TAHEA 2.60 SNAP TRSDA THSPC RATIO ISNOW ISAME LOCAL
 1 1 2.60 0.00 2.60 0.00 0.000 0 1 0

PRECIP DATA
 SPFE PMS R6 R12 R24 R48 R72 R96
 0.00 23.50 113.00 123.00 132.00 142.00 0.00 0.00
 TRSPC COMPUTED BY THE PROGRAM IS .600

LOSS DATA
 LROPT STAKR DLTAK RTIO ERAIN STRKS RTIOK STRTL CNSTL ALSMX RTIMP
 0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 .05 0.00 0.00

UNIT HYDROGRAPH DATA
 TP= 1.70 CP= .40 NTA= 0

RECESSION DATA
 STRTO= -1.50 ORCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.70 HOURS, CP= .40 VOL= 1.00
 55. 194. 345. 387. 345. 295. 252. 215. 184. 157.
 134. 115. 98. 84. 72. 61. 52. 45. 38. 33.
 28. 24. 20. 17. 15. 13. 11. 9. 8. 7.
 0. 5. 4. 4. 3. 3. 3. 3. 3. 3.

SHEET 11

0.3 PMF WITH BREACH OF DAM

NO.	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	NO.	PERIOD	RAIN	EXCS	LOSS	COMP Q
SUM	26.70	24.30	2.40	63614.							
	(676.)	(617.)	(61.)	(2367.68)							

HYDROGRAPH ROUTING

ROUTING THROUGH BEHNHART RESERVOIR

1STAG	1COND	1ECON	1TAP	1PLT	1PRT	1NAME	1STAG	1AUTO
OUTFLG	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

WLOSS	CLOSS	AVG	1RES	1SAME	1OPT	1PMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

1STPS	1STDL	LAG	AMSKN	X	TSK	STOR	1SPRAT
1	0	0	0.000	0.000	0.000	-395.	0

SURFACE AREA=	0.	13.	25.
CAPACITY=	0.	129.	448.
ELEVATION=	370.	395.	412.

CREL	SPWID	COOD	EXPW	ELEV	COOL	CAREA	EXPL
395.0	40.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA			
TOPEL	COOD	EXPD	DAMWID
399.7	3.1	1.5	150.

DAM BREACH DATA					
FRID	Z	ELB4	TFAIL	WSEL	FAILEL
50.	1.00	387.00	1.00	395.10	412.00

PEAK OUTFLOW IS 1675. AT TIME 42.00 HOURS

DAM BREACH DATA					
FRID	Z	ELB4	TFAIL	WSEL	FAILEL
50.	1.00	387.00	1.00	395.10	400.00

BEGIN DAM FAILURE AT 41.50 HOURS

PEAK OUTFLOW IS 3343. AT TIME 42.50 HOURS

SHEET 12

0.3 PMF WITH BREACH OF DAM

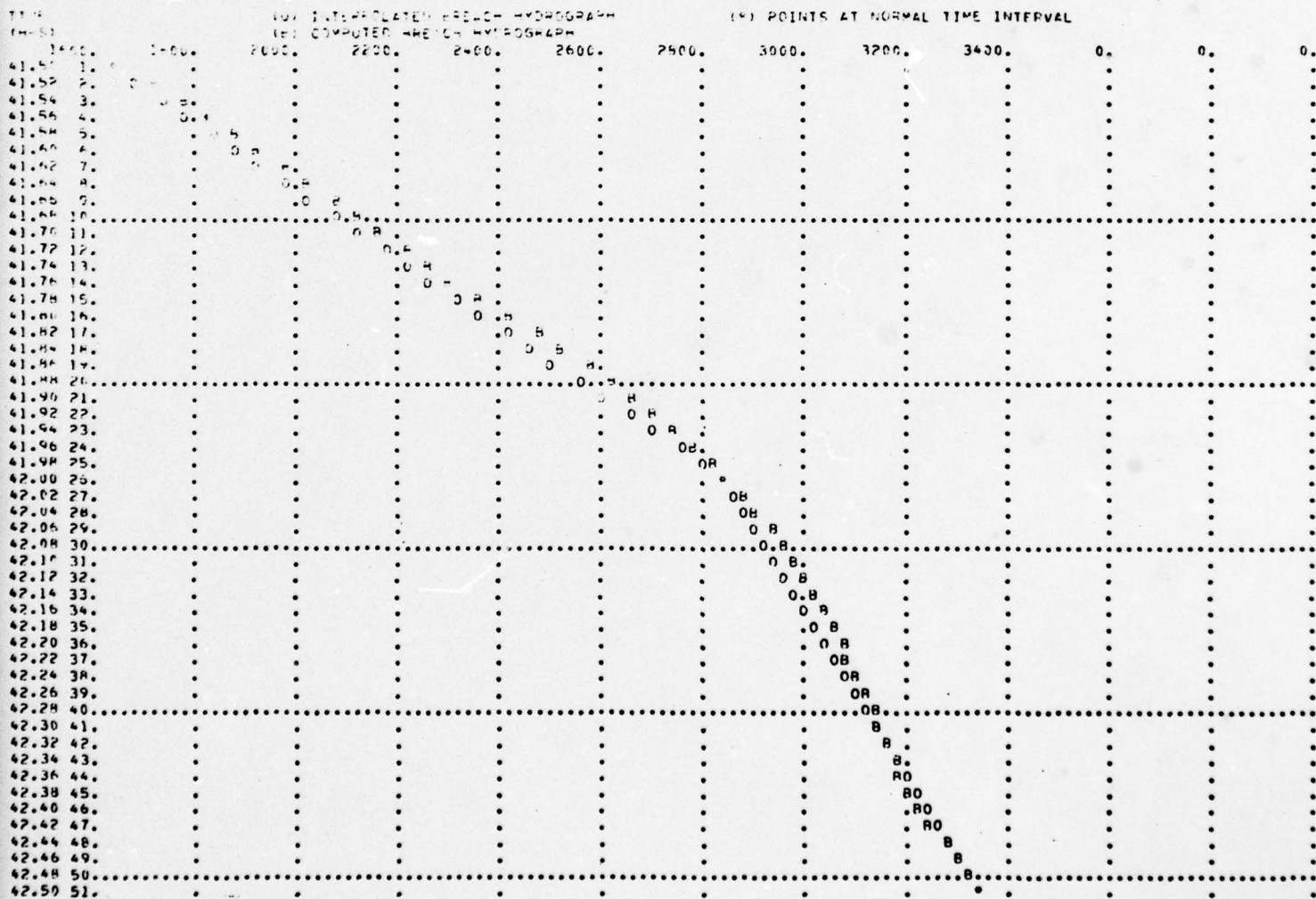
THE DAM BREAKDOWN CURVE WAS DEVELOPED USING A TIME INTERVAL OF .025 HOURS DURING BREACH FORMATION.
 THE STREAM GATE CALCULUS WILL USE A TIME INTERVAL OF .050 HOURS.
 THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
 INTERMEDIATE VALUES ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	= ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
41.500	0.000	1630.	1638.	0.	0.	0.
41.520	.020	1667.	1726.	-39.	-39.	-0.
41.540	.040	1735.	1775.	-40.	-79.	-0.
41.560	.060	1783.	1825.	-42.	-121.	-0.
41.580	.080	1832.	1876.	-44.	-165.	-0.
41.600	.100	1880.	1927.	-47.	-211.	-0.
41.620	.120	1929.	1977.	-48.	-260.	-0.
41.640	.140	1977.	2026.	-49.	-309.	-1.
41.660	.160	2026.	2075.	-49.	-358.	-1.
41.680	.180	2074.	2122.	-48.	-406.	-1.
41.700	.200	2122.	2169.	-47.	-453.	-1.
41.720	.220	2171.	2215.	-45.	-498.	-1.
41.740	.240	2219.	2262.	-43.	-540.	-1.
41.760	.260	2268.	2309.	-42.	-582.	-1.
41.780	.280	2316.	2360.	-44.	-626.	-1.
41.800	.300	2364.	2418.	-53.	-679.	-1.
41.820	.320	2413.	2473.	-60.	-739.	-1.
41.840	.340	2461.	2525.	-63.	-802.	-1.
41.860	.360	2510.	2574.	-64.	-867.	-1.
41.880	.380	2558.	2621.	-63.	-930.	-2.
41.900	.400	2607.	2665.	-58.	-988.	-2.
41.920	.420	2655.	2706.	-51.	-1039.	-2.
41.940	.440	2703.	2745.	-42.	-1081.	-2.
41.960	.460	2752.	2782.	-30.	-1111.	-2.
41.980	.480	2800.	2816.	-16.	-1128.	-2.
42.000	.500	2849.	2849.	0.	-1128.	-2.
42.020	.520	2888.	2879.	-10.	-1138.	-2.
42.040	.540	2888.	2907.	-19.	-1157.	-2.
42.060	.560	2908.	2933.	-25.	-1182.	-2.
42.080	.580	2928.	2957.	-30.	-1211.	-2.
42.100	.600	2948.	2980.	-33.	-1244.	-2.
42.120	.620	2967.	3001.	-34.	-1278.	-2.
42.140	.640	2987.	3021.	-34.	-1312.	-2.
42.160	.660	3007.	3040.	-33.	-1345.	-2.
42.180	.680	3027.	3057.	-30.	-1375.	-2.
42.200	.700	3046.	3074.	-27.	-1402.	-2.
42.220	.720	3066.	3089.	-23.	-1425.	-2.
42.240	.740	3086.	3104.	-18.	-1443.	-2.
42.260	.760	3106.	3118.	-13.	-1456.	-2.
42.280	.780	3126.	3132.	-7.	-1463.	-2.
42.300	.800	3145.	3146.	-1.	-1463.	-2.
42.320	.820	3165.	3160.	5.	-1458.	-2.
42.340	.840	3185.	3174.	11.	-1446.	-2.
42.360	.860	3205.	3188.	17.	-1430.	-2.
42.380	.880	3224.	3204.	21.	-1409.	-2.
42.400	.900	3244.	3221.	23.	-1385.	-2.
42.420	.920	3264.	3242.	22.	-1363.	-2.
42.440	.940	3284.	3271.	13.	-1350.	-2.
42.460	.960	3304.	3300.	3.	-1347.	-2.
42.480	.980	3323.	3324.	-1.	-1348.	-2.
42.500	1.000	3343.	3343.	0.	-1348.	-2.

SHEET 13

0.3 PMF WITH BREACH OF DAM

STATION NOTED



SHEET 14

0.3 PMF WITH BREACH OF DAM

HYDROGRAPH ROUTING

ROUTING DOWNSTREAM OF HERHART RESERVOIR

ISTAN	ICOMP	IECON	ITRPF	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAZARD	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

ROUTING DATA

GLSSS	GLSSS	AVG	IRIS	ISAMP	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKY	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

CH(1)	CH(2)	CH(3)	ELNVT	ELMAX	PLNTH	SFL
.0400	.0500	.0700	340.0	360.0	600.	.01300

CROSS SECTION COORDINATES--STA.ELFV,STA.ELEV--ETC

0.00	340.00	60.00	360.00	120.00	344.00	125.00	340.00	135.00	340.00
140.00	342.00	440.00	340.00	690.00	380.00				

	0.00	.17	.41	.62	1.52	2.51	3.81	5.42	7.35	9.59
STORAGE	12.14	15.00	18.17	21.60	25.45	29.56	33.98	38.71	43.75	49.10
OUTFLOW	0.00	62.09	214.20	498.67	977.79	1742.65	2825.23	4276.86	6144.66	8472.85
	11303.47	14676.72	18631.32	23204.70	28433.13	34351.90	40995.40	48397.20	56590.13	65606.35
STAGE	340.00	341.05	342.11	343.16	344.21	345.26	346.32	347.37	348.42	349.47
	350.53	351.58	352.63	353.68	354.74	355.79	356.84	357.89	358.95	360.00
FLOW	0.00	62.09	214.20	498.67	977.79	1742.65	2825.23	4276.86	6144.66	8472.85
	11303.47	14676.72	18631.32	23204.70	28433.13	34351.90	40995.40	48397.20	56590.13	65606.35

MAXIMUM STAGE IS 345.2

MAXIMUM STAGE IS 346.7

SHEET 15

0.3 PMF WITH BREACH OF DAM

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN RATIO		RATIOS APPLIED TO FLOWS
			1	.30	
HYDROGRAPH AT INFLUENCE	(6.73)	2.60	1	1588.	
			(	47.81)	(
			2	1588.	
			(	47.81)	(
ROUTED TO OUTLET	(6.73)	2.60	1	1575.	
			(	47.44)	(
			2	3343.	
			(	94.67)	(
ROUTED TO HAZARD	(6.73)	2.50	1	1683.	
			(	47.65)	(
			2	3369.	
			(	95.39)	(

SHEET 16

0.3 PMF WITH BREACH OF DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	395.10	395.00	399.70
	OUTFLOW	130.	129.	194.
		4.	0.	1263.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	400.24	.54	207.	1675.	3.00	42.00	0.00

PLAN 2	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	395.10	395.00	399.70
	OUTFLOW	130.	129.	194.
		4.	0.	1263.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	400.19	.49	206.	3343.	1.24	42.50	41.50

PLAN 1 STATION HAZARD

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.30	1683.	345.2	42.00

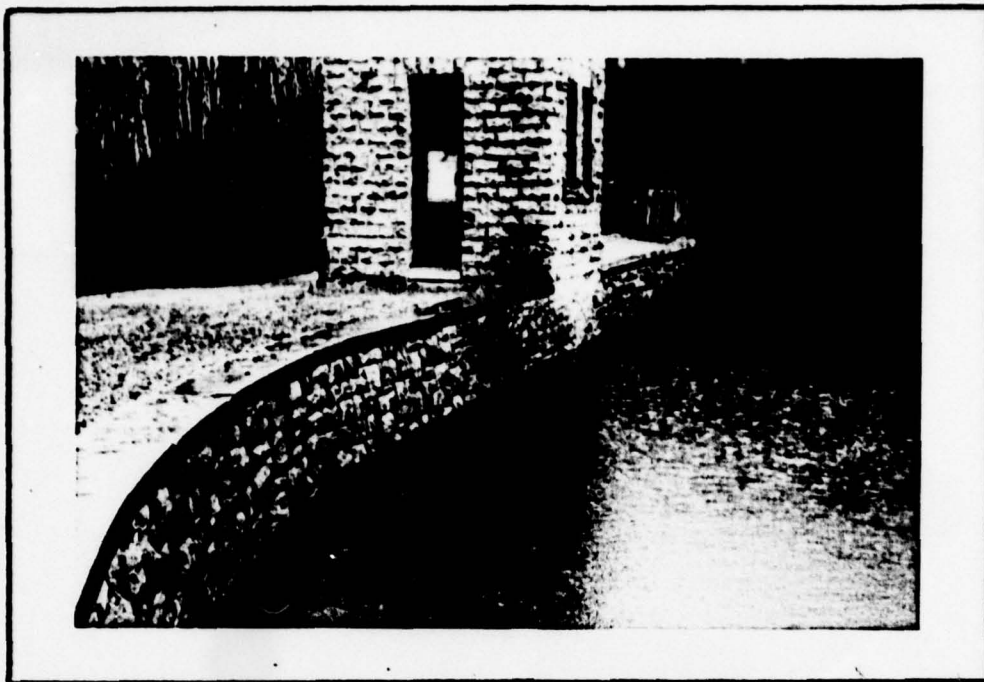
PLAN 2 STATION HAZARD

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.30	3343.	346.7	42.50

APPENDIX

D

Photographs



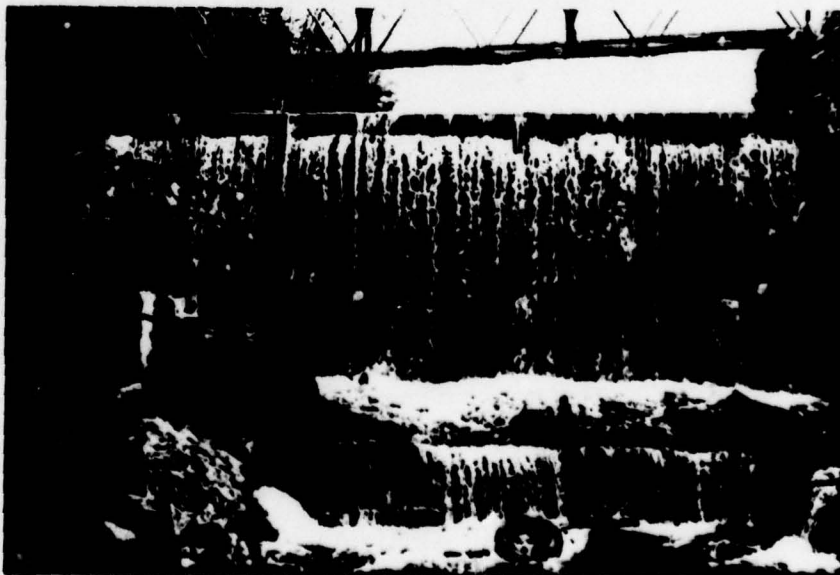
*UPSTREAM FACE OF THE DAM SHOWING THE GATE HOUSE
AND THE VEGETATION GROWING FROM THE MASONRY WALL*



*VIEW SHOWING THE FOOT BRIDGE OVER THE SPILLWAY
AND THE LACK OF VEGETATION ON PORTIONS OF THE DAM*



*SPILLWAY CREST AS VIEWED
FROM THE RIGHT ABUTMENT*



*VIEW SHOWING THE FOOT BRIDGE, DROP SPILLWAY,
AND DOWNSTREAM APRON*



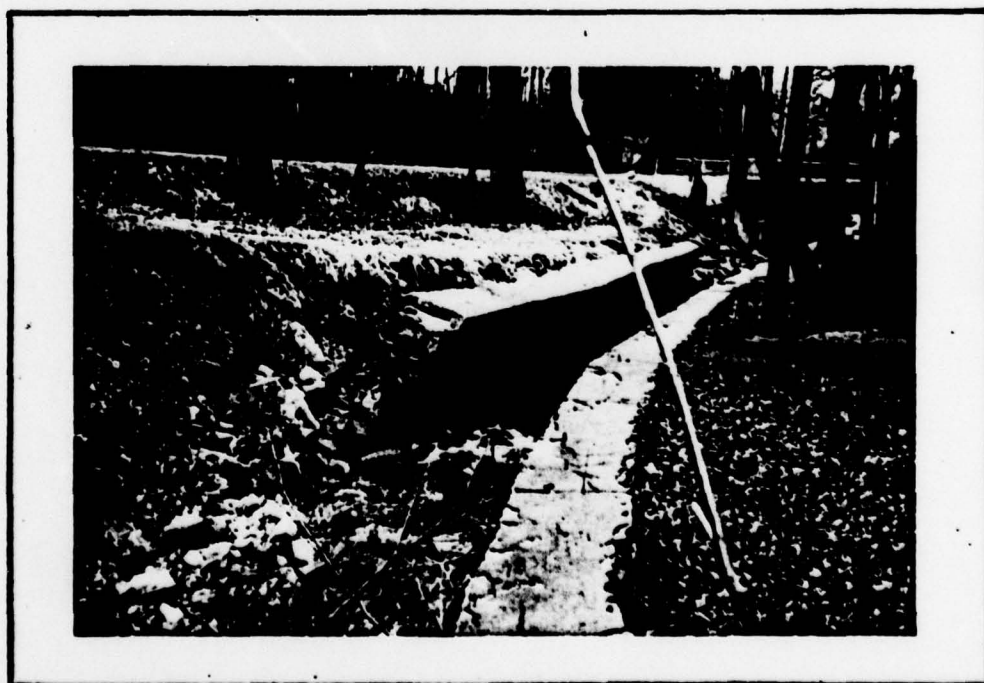
*SPILLWAY DISCHARGE CHANNEL LOOKING
DOWNSTREAM FROM THE FOOT BRIDGE*



*LOOKING UPSTREAM AT THE DETERIORATED
TRAINING WALL IN THE SPILLWAY OUTLET CHANNEL*



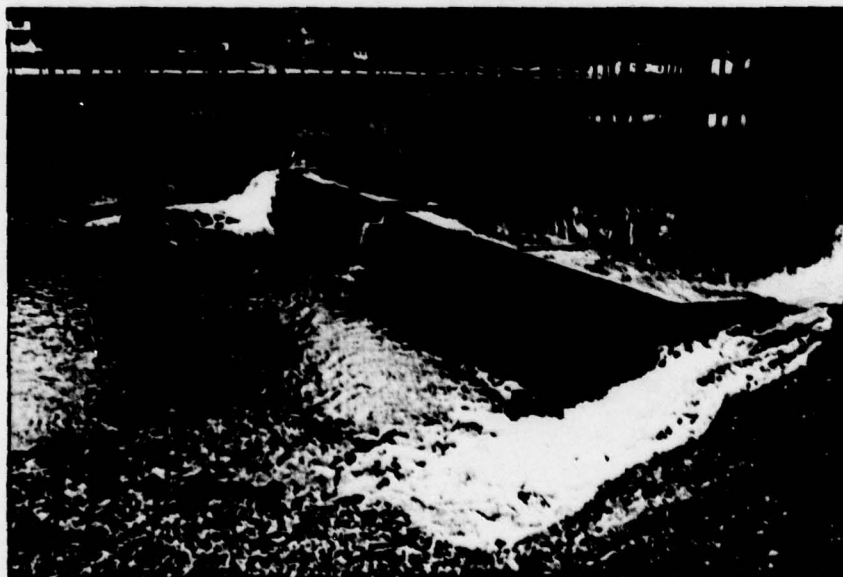
*DISCHARGE FROM A 40-INCH PIPE AND UNDERMINING
OF THE LEFT TRAINING WALL IN THE SPILLWAY OUTLET CHANNEL*



*LOOKING DOWNSTREAM AT THE CRUMBLed AND DISPLACED
LEFT TRAINING WALL IN THE SPILLWAY OUTLET CHANNEL*



*SPILLWAY OUTLET CHANNEL LOOKING DOWNSTREAM
TOWARDS THE BRIDGE SECTION WHICH IS ABOUT
400 FEET DOWNSTREAM OF THE DAM*



*UPSTREAM SETTLING BASIN SHOWING EROSION
AT THE ENDS OF THE SPILLWAY AND SEDIMENT ACCUMULATION*

APPENDIX

E

Drawings

TABLE OF CONTENTS - APPENDIX E

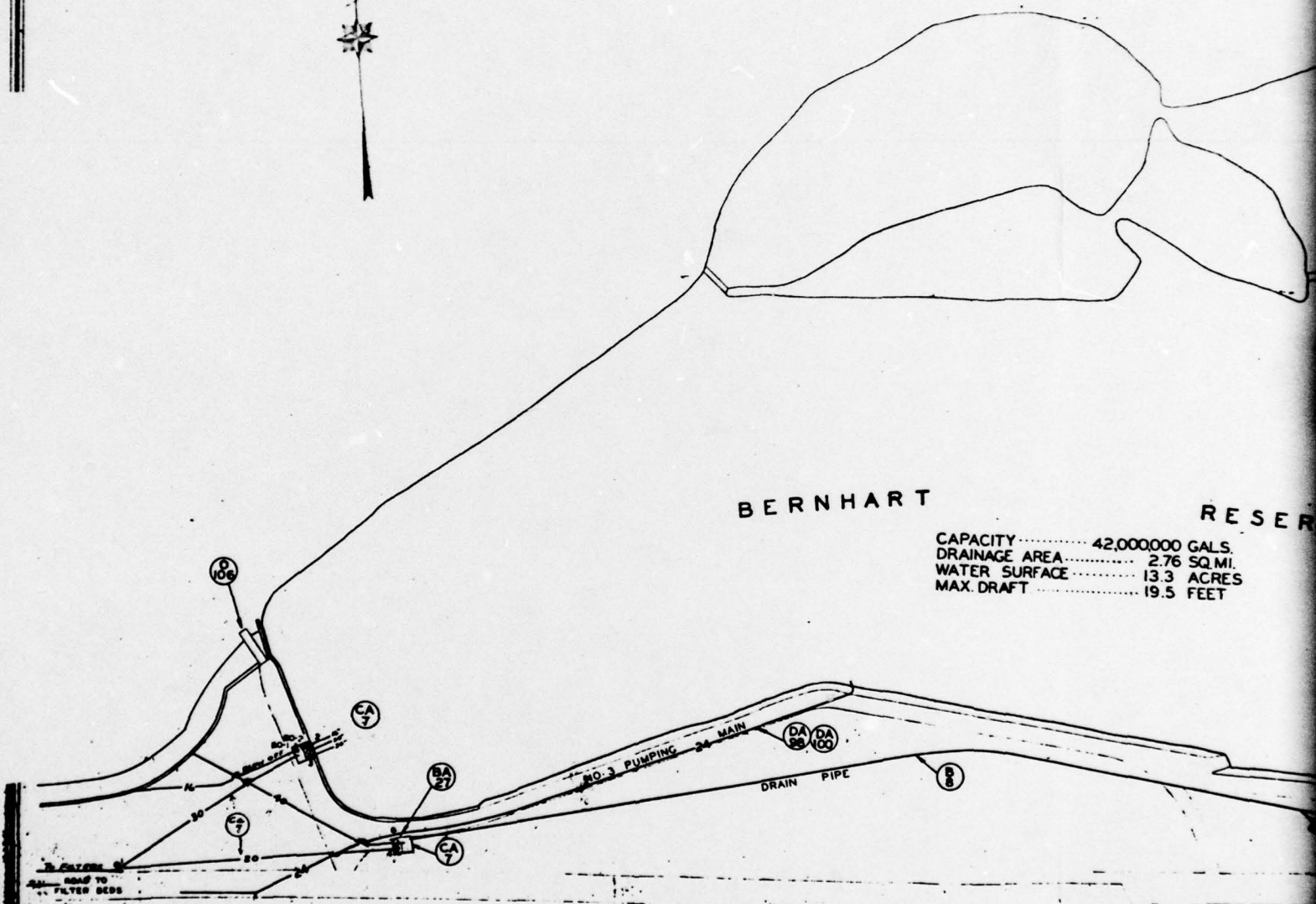
REGIONAL VICINITY MAP	PLATE 1
PLAN VIEW OF RESERVOIR	PLATE 2
GATEHOUSE PLANS	PLATE 3
GENERAL PLAN DRAWING SHOWING PROBLEM AREAS	PLATE 4
PROFILE OF TOP OF DAM @ TIME OF INSPECTION	PLATE 5



BERNHART

RESER

CAPACITY 42,000,000 GALS.
DRAINAGE AREA 2.76 SQ. MI.
WATER SURFACE 13.3 ACRES
MAX. DRAFT 19.5 FEET



BR

FOR LOCATION OF FOUNTAINS
SEE GENERAL FIELD NOTES
BUOY NO. 8 PAGES 128-129
ALSO HANDING ONE NO. 8

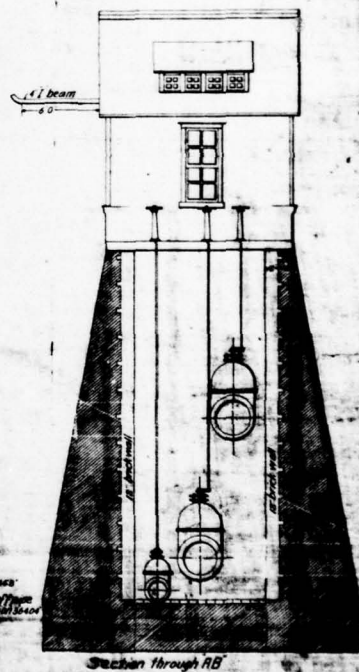
RESERVOIR

42,000,000 GALS.
2.76 SQ. MI.
13.3 ACRES
19.5 FEET

SETTLING
BASIN

2
PLATE 2

SCALE 1:1000



Department of Water



O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT

BERNHART DAM

SHEET

BY

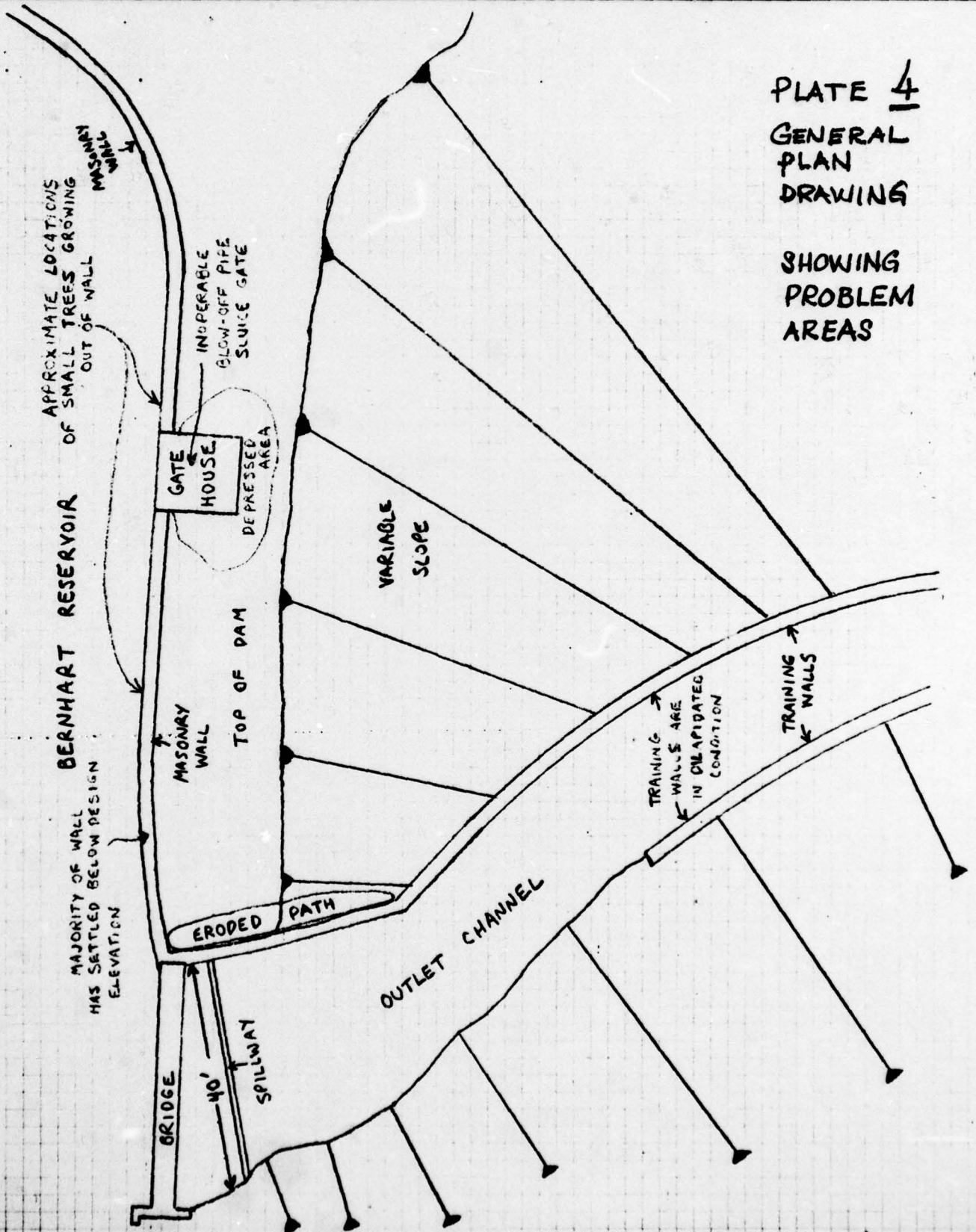
RRB

DATE

JOB NO

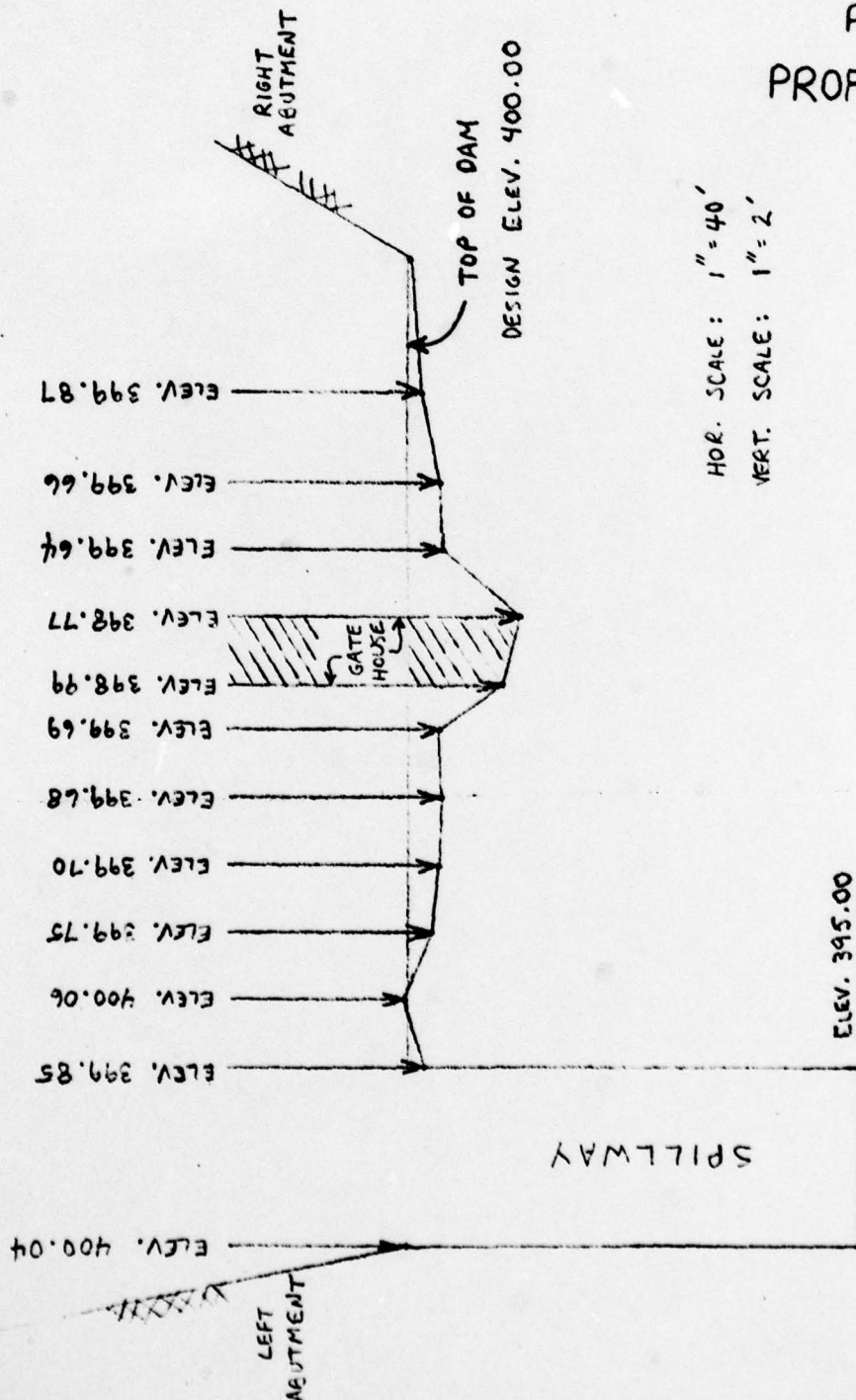
PLATE 4
GENERAL
PLAN
DRAWING

SHOWING
PROBLEM
AREAS



SUBJECT	SHEET	BY	DATE	JOB NO.
BERNHART DAM				

PLATE 5
PROFILE OF CREST
OF DAM



HOR. SCALE: 1" = 40'
VERT. SCALE: 1" = 2'

APPENDIX

F

Site Geology

SITE GEOLOGY

BERNHART DAM

Bernhart Dam is located in the western section of the Reading Prong of the New England Uplands physiographic province. The crystalline rocks in this province are folded and highly faulted complex Precambrian metamorphics. Bedrock at the dam site has a gneissic structure as indicated by inspection of the outcrop forming the right abutment and by geologic mapping performed by other investigators. No major faulting or structural defects were noted in the field in the immediate vicinity of the dam or reservoir.

